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Abstract

This paper analyses bank relative riskiness by testing the sensitivity of Asia-Pacific banks to overall market risk, global credit risk shocks, interest rate risk shocks and maturity risk shocks. The banks' risk profiles are categorised according to their capitalisation levels and functional degree of diversification. Our results indicate that highly capitalised banks yield higher average stock returns whilst functionally diversified banks have less volatile returns. Generally, banks that adopt capital adequacy guidelines and hold higher capital levels have greater protection from these risks. Functionally diversified banks are also more strongly positioned against system-wide shocks to the banking sector.

JEL classification: F34, G12, G21

Key words: Asia Pacific bank risk, market risk, credit risk, capitalisation, functional diversification

1. Introduction

The last 100 years have seen banks coping with problems relating to asymmetric information during and following episodes of shocks to the banking system. These shocks lead to a deterioration of the overall economic environment and more frequently, increased volatility levels in financial markets. During economic upswings, lending volumes tend to rise but the banks' natural response during downswings would be to tighten lending practices and sometimes invoke credit rationing. Nonetheless, existing loans and open trading positions threaten the value of banks' as firms.

Bank assets are relatively opaque to the general public as they cannot be seen directly. If markets are efficient, then one way to observe the impact of exogenous economic events on the financial healthiness of banks is to examine the stock market's evaluation of bank equity. As financial intermediaries, banks are inherently exposed to credit, interest rate, market, liquidity, foreign exchange, and country risks. Some risks are likely to have more significant effects on some banks than others, and they are sometimes inter-related.

Adverse shifts in financial market conditions can worsen the creditworthiness of banks' borrowers. To manage their exposure against some of the associated risks, banks can hedge risky positions by using "off-balance sheet" activities. Other risk management methods include functional diversification of income sources and the holding of higher capital levels to back up riskier loans. Since banks now operate globally, not only are they concerned with domestic economic conditions, but shocks to the global financial system affect them too.

The widely accepted risk-based capital adequacy ratio (RBC) standard of 8% proposed by the Bank of International Settlements has now been adopted by banking systems in both developed and emerging economies as a benchmark in the formulation of capital regulation policies. However, banks can signal their financial strength and maintain confidence of their own creditworthiness by choosing to hold higher capital levels. Capital "cushioning" can protect against potential contingent losses, thereby lowering the risk of bank failure and can implicitly lead to lower funding costs. This in turn, implies that banks with a relatively higher level of capitalisation should be less sensitive to adverse changes in market and credit conditions and thereby less sensitive to credit risk (Landschoot and Vander Vennet, 2001).

In their efforts to maintain competitiveness in an increasingly sophisticated and global financial market system, a popular trend for banks is to adopt functional diversification, integrating non-traditional financial services such as commercial banking, insurance, investments and superannuation into their business model. Functional diversification reduces the dependence on interest income and hence, increases the proportion of non-interest income. Dewenter and Hess (1998) provide evidence that universal banks tend to be less risky than their specialised counterparts. Therefore, this implies that functionally diversified banks should be less sensitive towards adverse changes to regional and international credit and interest rate risk compared to specialised banks.

This paper assesses the sensitivity of Asia-Pacific banks grouped under different risk profiles according to their degrees of capitalisation and functional diversification against changes to global credit risk, and to regional market, interest rate and maturity risks.[1] In comparison with previous studies, not all of the countries in our sample adopted the BIS capital adequacy standard of 8%. We explore the desirability for banks in the Asia-Pacific region to adopt stricter capital adequacy rules and to become more functionally diversified. We proceed to assess their risk premiums, which will indicate the propensity of each profile group to hedge against each risk component. A statistical strength of our study is the avoidance of the errors-in-the-variables problem, achieved by forming equally weighted and value weighted portfolios as well as using the Generalised Method of Moments (GMM) as a means of estimation of our four-factor APT model.

We draw three main lessons drawn from the study: first, less diversified banks rely heavily on interest income and so must aim to maintain high capital levels to protect against deterioration of their borrowers' creditworthiness. Second, diversified banks should not be misled to believe that diversification allows for riskier lending practices. Finally, in order for capital adequacy ratios to be an effective strengthening tool and bulwark against risks, accounting and classification standards in relation to what constitutes equity levels should be consistent with those of developed economies and international standards so as to ensure consistency in international comparisons.

The organisation of the paper is as follows: in Section 2 we review the literature relating to the importance of financial and banking system stability, developments and possible implications of bank regulation and market disciplinary forces and commonly applied indicators of bank fragility. Section 3 sets out our proposed four-factor model and our research hypotheses. We discuss our general procedure, data selection and analysis in Section 4. Our findings follow in Section 5, where we present our empirical results and derive some general conclusions about the characteristics of each risk profile group and we make some suggestions about future risk management developments for Asia-Pacific banks. Section 6 concludes.

2. Literature Review

Bank crises can occur in both developed and emerging economies. Kaminsky and Reinhart (1999) and Rossi (1999) established a causal relationship between banking and currency crises and found that during recessions, banks typically suffer substantial losses, sometimes even to the extent of requiring costly government bailouts. Hoggarth, Reis and Saporta (2002) provide an extensive review of the fiscal and output losses incurred by bank crises for both developed and emerging economies. Over the period of 1992 – 2002, 24 major crises studied indicated that losses averaged from 15 – 20% of GDP and the restoration costs for distressed banks were much larger for emerging economies that for those with higher degrees of banking intermediation. They also note that currency crises and large recessions that worsen economic conditions can ultimately translate into banking crises for these emerging economies.

Thus, regulation of the banking systems is crucial for both financial systems and the smooth operation of economies. While it is widely known that capital adequacy ratios have had significant impact on banks' risk taking behaviour, studies on this issue have form two main streams. The first school of thought argues that the regulation causes banks to withstand negative shocks. The other stream suggests that regulation causes banks to change their attitudes towards risk taking and instead could have a variety of effects, including causing banks to prefer less risky loans so as to reduce their capital held, thus reducing banks' overall profitability (Chiuri, Ferri and Majnoni, 2002). Nevertheless, this literature on the impact of RBC for bank's asset risk is quite an extensive and sometimes a contradictory one. For example Furlong and Keeley (1989) show that capital requirements reduce risk-taking incentives in the case of value-maximising banks. Whilst Flannery (1989) suggests that there actually might be an inducement towards higher risk-taking. Koen and Santomero (1980) and Rochet (1992) demonstrate in a mean variance framework that RBC combined with inappropriate risk weights may increase bank riskiness. Some, such as Boot and Greenbaum (1993) have argued that RBC requirements reduce monitoring incentives and this then serves to reduce the quality of bank portfolios. Gehrig (1995) suggests that RBC affect the nature of strategic competition between banks. Finally, Blum (1999) also argues that in a dynamic framework RBC may increase a bank's riskiness.

However, Saunders (2002) comments that the introduction of capital adequacy standards may cause banks to prefer lending to the public sector rather than the private sector, since capital requirements would be lower. In the case of emerging economies with under-developed capital markets, this would lead to a credit shortage for the private sector that depends heavily on bank credit.[2]

A further issue concerns the fact that RBC may be open to manipulation. Jones (2000) suggests that securitisation and other financial innovations have provided opportunities for banks to substantially reduce their RBC based measures of risk. This is typically matched by little reduction in actual economic risks. He terms this process 'regulatory capital arbitrage'. This leads to the possibility that reported RBC ratios could mask deterioration in the true financial conditions of banks. Furthermore, there may be associated competitive inequities in that regulatory capital arbitrage may not be equally available to all banks and may be related to differences in economies of scale and scope, or to differences in accounting, supervisory and legal regimes.

This is related to the issue that evidence on the usefulness of capital adequacy ratios might not equally apply to emerging markets. Sach, Tornell and Velasco (1996) point out that capital adequacy and liquidity standards typically emphasised in developed economies may not be sufficient to regulate the more volatile emerging markets. Similarly, Rojas-Suarez (2001) also found that capital standards have little supervisory usefulness in emerging markets due to the structure of their financial sectors in comparison to developed economies.

Recent trends focus on the issue of market discipline as a supplementary tool to traditional supervisory standards. Crockett (2002) points out that market forces are powerful disciplinary tools because of the speed and efficiency in which information is reflected in prices. Good risk taking behaviour will be rewarded with share price increases. Sironi (2002) also states two reasons for the need for market discipline. First, because banks tend to operate globally, their domestic regulator has limited control on their risk taking behaviour. Secondly, with the implementation of capital adequacy standards, banks are now applying their own market risk models to determine capital levels provided that they conform to general guidelines of the BIS, and therefore there is much room for independent judgement.[3]

Studies by Kaminsky and Reinhart (1999) and Demirguç-Kunt and Detragiache (2000) focus on the macroeconomic factors that help predict banking and currency crises. However, few studies have tried to analyse the origins of the East Asian crisis using individual bank data. Bongini, Claessens and Ferri (2001) addressed this issue by using traditional CAMEL-type indicators to help predict bank distress and failure in the East Asian crisis countries.[4] Bongini, Laeven and Majnoni (2002) studied banks active before and during the Asian currency crises and found that stock prices and credit ratings did not outperform balance sheet information as indicators of fragility and that stock market information responded much faster to changing financial conditions compared to credit ratings. Konishi and Yasuda (2004) analyse risk taking by Japanese banks and conclude that the adoption of RBC has served to reduce risk-taking by Japanese banks.

Recent studies have argued that public information about the impact of economic events relevant to the financial health of banks should be reflected in stock market valuation. The evidence suggests that the market is able to efficiently react to information concerning individual banks and to changes in the regulatory environment. This suggests that markets have the ability to assess the quality of banks' assets. Since stock price information can provide valuable information about the soundness of banks and is relatively easy to obtain, using this type of information could be beneficial for both investors and prudential regulators (Berger, Davies and Flannery, 2000, De Young; Flannery, Lang and Sorescu, 2001; Bongini et al., 2002).

3. Testing Hypotheses and methodology

We used a four-factor APT model to test the sensitivity of bank returns to overall market risk (*M*), credit risk shocks (*CR*), interest rate risk shocks (*IR*) and maturity risk shocks (*MR*). If markets are efficient, then banks returns should only react to unanticipated components of the risk factors. Related studies that have examined the effects of market, credit and maturity risks include Dewenter and Hess (1988), Demsetz and Strahan (1998) and

Landschoot and Vander Vennet (2001). Other studies such as those by Sweeney and Warga (1986), Yourougou (1990), Choi, Elyasiani and Kopecky (1992) and Allen and Jagtiani (1996) have looked at the effects of market and interest rate risks on bank returns.

Assuming bank returns (R_t^i) follow a factor model of the form specified by Ross (1976) and Shanken (1982)[5]:

$$R_t^i = \alpha + \beta_M \, UM_t + \beta_{CR} \, UCR_t + \beta_{IR} \, UIR_t + \beta_{MR} \, UMR_t + \varepsilon_t^i \tag{1}$$

where $UM_t = M_t - \mu_{Mt}$, $UCR_t = CR_t - \mu_{CRt}$, $UIR_t = IR_t - \mu_{IRt}$ and $UMR_t = MR_t - \mu_{MRt}$ are the unexpected parts of the market, credit, interest rate and maturity risk factors at time *t*. β_M, β_{CR}, β_{IR} and β_{MR} are the loadings on the state variables, α is a constant term and ε_t^i is the idiosyncratic error term.

The second part of our analysis examines the factor betas in (1) to see if they translate into economically meaningful risk premiums. Expanding from the APT framework, the second pass regression yields the associated risk premiums λ_M, λ_{CR}, λ_{IR} and λ_{MR} (Shanken, 1982). We augment equation (1) into the representation:

$$R_t^i = \alpha + \beta_M \, [M_t - \mu_{Mt}] + \beta_{CR} \, [CR_t - \mu_{CRt}] + \beta_{IR} \, [IR_t - \mu_{IRt}] + \beta_{MR} \, [MR_t - \mu_{MRt}] + \varepsilon_t^i \tag{2}$$

Under the condition of no-arbitrage, (2) implies that:

$$\mu_R^i = \lambda_0 + \beta_M^i \lambda_M + \beta_{CR}^i \lambda_{CR} + \beta_{IR}^i \lambda_{IR} + \beta_{MR}^i \lambda_{MR} \tag{3}$$

If there is a riskless asset with a return of μ_{RF}, then $\beta_F = 0$ and $\mu_{RF} = \lambda_0$. If there is no riskless asset, then λ_0 would be the expected rate of return on a zero-beta portfolio.

By substituting equation (2) into (3), the empirical model for the APT may be expressed as:

$$R_t^i = \lambda_0 + \beta_M^i [\lambda_M - \mu_M] + \beta_{CR}^i [\lambda_{CR} - \mu_{CR}] + \beta_{IR}^i [\lambda_{IR} - \mu_{IR}] + \beta_{MR}^i [\lambda_{MR} - \mu_{MR}] \\ + \beta_M^i M_t + \beta_{CR}^i CR_t + \beta_{IR}^i IR_t + \beta_{MR}^i MR_t + \varepsilon_t^i \tag{4}$$

Since the factors are exogenously specified as the innovations of the factors, equation (4) includes the risk shocks, *UM*, *UCR*, *UIR* and *UMR*. Finally, denoting $\delta_M = \lambda_M - \mu_M$, $\delta_{CR} = \lambda_{CR} - \mu_{CR}$, $\delta_{IR} = \lambda_{IR} - \mu_{IR}$ and $\delta_{MR} = \lambda_{MR} - \mu_{MR}$, and replacing each factor by its innovation, (4) can be specified as:

$$R_t^i = \lambda_0 + \beta_M^i \delta_M + \beta_{CR}^i \delta_{CR} + \beta_{IR}^i \delta_{IR} + \beta_{MR}^i \delta_{MR} + \beta_M^i UM_t + \beta_{CR}^i UCR_t \\ + \beta_{IR}^i UIR_t + \beta_{MR}^i UMR_t + \varepsilon_t^i \tag{5}$$

Following the approaches of Fama and MacBeth (1973) and Chen, Roll and Ross (1986), estimating equation (1) could enable the derivation of the factor betas for each individual bank and these beta estimates from the first pass regression could be applied as independent variables in the second pass regression of (3) to obtain estimates for the factor risk premiums. However, equation (3) is specified in terms of true betas, whereas the first pass regression only yields estimates for the betas. Fama and MacBeth (1973) warn that this two step approach results in an errors-in-variables problem, implying that the estimates are inconsistent and biased.

To control for this problem, Chen, Roll and Ross (1986) and Banz (1981) suggest grouping returns into equally weighted and value weighted portfolios to reduce the noise of individual returns. Our study also constructs equally weighted and value weighted portfolios for each risk group category. We construct equally weighted portfolios since systematic risk should affect all banks, regardless of size. However, an alternative argument is that large banks are those that matter when financial system stability is concerned and therefore, value weighted portfolios must be used.

A better approach to avoid the problem of errors-in-variables is to simultaneously estimate the betas and risk premiums for the factors using the GMM (Hansen, 1982). This technique allows us to use time series together with cross sectional information and constrains the λ's and μ's of each factor to be identical across individual banks and for portfolios of banks in each risk group. GMM also allows for estimation despite the presence of serial correlation and heteroskedasticity in the factors. It chooses the factor betas that minimises the quadratic form in the sample moment conditions:

$$\hat{\beta}_{GMM} = \arg\min_{\beta} \ \overline{m}\,(\beta)'\ \mathrm{W}\ \overline{m}\,(\beta) \tag{6}$$

β is a K-vector of parameters, $\overline{m}\,(\beta)$ is an L-vector of orthogonality conditions, and W is an T×T positive definite weighting matrix. An important contribution by Hansen (1982) is to point out that setting W = S^{-1}, where S^{-1} is the inverse of an asymptotic covariance matrix, then W is optimal in the sense that it yields the estimated parameters $\hat{\beta}$ with the smallest asymptotic variance. More weight is attached to the moment conditions that have smaller variances.

The main hypotheses in our study, based on the risk factors faced by banks inherent in the process of financial intermediation are:

- Banks are exposed to credit risk due to the creditworthiness of their borrowers. Hence, it is expected that their stock returns exhibit sensitivity to credit risk shocks ($\beta^{i}_{CR} < 0$) and the risk premium should be positive ($\lambda_{CR} > 0$). The risk premium for unanticipated shocks to credit spread should be positive because banks would want to hedge against unanticipated increases in the aggregate risk premium accompanying an increase in uncertainty (Chen, Roll and Ross, 1986).
- Functionally diversified banks should be less sensitive to credit risk shocks than specialised banks, because they have lesser reliance on loans as a source of income ($\beta^{FD}_{CR} < \beta^{NFD}_{CR}$). Universal banking carries diversification benefits applied similarly to portfolio theory concepts (Dewenter and Hess, 1988).
- Highly capitalised banks should be less sensitive to credit risk shocks than those with lower equity to asset ratios ($\beta^{HC}_{CR} < \beta^{PC}_{CR}$), because they can use their equity as working capital to cover themselves against losses (Berger, 1995).
- The sensitivity of banks with respect to credit risk differs within subgroups. Hence, the stock market should be able to assess the cross-sectional differences of banks' credit risk exposure (Fama and French, 1993).
- Shocks to the short-term interest rate (*UIR*) and the maturity spread (*UMR*) affect banks' interest income. While it can be expected that ($\beta^{i}_{IR} < 0$), the associated risk

premium (λ_{IR} >0) should also be positive because banks would want to limit their potential downside risk of earnings. Depending on the ratio of long to short-term assets, changes to the maturity spread can affect bank returns positively or negatively ($\beta^{i}_{MR} \neq 0$), and so the propensity for banks to hedge this imbalance would also be of opposite sign.

4. The estimation sample and testing strategy

We assessed the sensitivity of banks categorised under four different risk profiles in Australia, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, South Korea, Singapore, Taiwan and Thailand against changes to global credit risk, regional market, interest rate and maturity risks.[6]

Monthly stock returns for our sample of 162 banks from the period of the 1st January 1992 to 1st January 2002 were used. A broad market proxy (M) was constructed using a regional index comprising the major stock exchanges of each country included in the sample, value-weighted by market capitalisation.

The credit spread (CR) used in the estimations is the difference between a portfolio of corporate bond yields and government bonds. The credit spread has been used in various studies such as Chen et al. (1986) as a proxy for credit risk. This global portfolio comprises yields for Australia, Canada, Japan, Sweden, Switzerland, U.K. and U.S. The composite measure of world credit risk is constructed as the GDP-weighted average of spreads for those countries. A credit spread measure comprising a regional portfolio for the 11 sample countries could not be used because consistent data for each country dating back to 1992 could not be obtained from Datastream.

The interest rate factor (IR) is a constructed portfolio of the GDP-weighted average 3-month indicator rate for Australia, Hong Kong, Japan and Singapore. Since the corresponding 3-month rates for the other countries in the sample was unavailable from Datastream, this interest rate factor should serve as a good proxy for interest rate movements for the East Asian region.

The maturity spread (MR) is the difference between a 10-year government bond yield and the 3-month interest rate for Australia, Japan, Hong Kong and Singapore. This regional portfolio was constructed as the GDP-weighted average of spreads for those countries. Again, the relevant data for this measure could not be obtained from Datastream for the rest of the countries in the sample study due to inconsistent start dates and definitions.

Accounting data for each bank in the sample was also collected. Information on Total Income, Total Assets, Net Interest Income and Total Income was obtained from Datastream. From this, Non-Interest Income was calculated by taking the difference between Total Income and Net Interest Income. The banks were grouped into one of four risk profile groups, namely:

- Highly Capitalised/ Functionally Diversified (HCFD)
- Highly Capitalised/ Not Functionally Diversified (HCNFD)
- Poorly Capitalised/ Functionally Diversified (PCFD)
- Poorly Capitalised/ Not Functionally Diversified (PCNFD)

Highly Capitalised (HC) banks are those that have a total equity to assets ratio of more than 6%, while Poorly Capitalised (PC) banks are those with ratios less than 6%. Australia conforms to the 8% capital adequacy guideline where it is stipulated that 4% must be made up of Tier 1 Core Capital (Saunders & Lange, 2000, p. 322). Tier 1 capital is closely linked to a bank's book value of equity reflecting the concept of the core capital contribution of a bank's owners. It includes the book value of ordinary shares, an amount of irredeemable preference shares and minority equity interests held by the bank in subsidiaries. Therefore, the measure of total equity reported for those banks should capture Tier 1 capital. The benchmark of 6% was chosen because it is a fair margin above the 4% minimum sufficient to be considered high capitalisation.

For a bank to be categorised as Functionally Diversified (FD), the ratio of non-interest income to total income has to be greater than 15% as applied by Vander Vennet and Landschoot (2001). Banks whose proportion of non-interest income to total income was less than 15% are considered Not Functionally Diversified (NFD) as they have heavier reliance on the interest margin between their assets and liabilities for profitability.

The grouping of the total 162 banks in the sample can be summarised as follows:

[Insert table 1 here]

There are a total of 56 banks classified as HCFD, while 98 banks are PCFD. This is because almost half of the sample banks taken were Japanese banks, and they have been found to enjoy a funding cost advantage by operating with significantly lower capital-to-assets ratio compared to other G10 countries (Wagster, 1996). Before the Basel Capital Accord was imposed, the average capital-to-assets ratio was 2.11% and these low levels have been persistent even in recent years. The low capital levels of these banks may bias our tests and so a new risk profile group PCFD2 was included in the analysis, which excludes all Japanese banks.[7]

The factors *M*, *CR*, *IR* and *MR* were tested for unit roots and differenced accordingly into stationary processes. Then, the unanticipated components of the factors were derived using a VAR framework and using GMM, we regressed the returns of each bank in the portfolios against the derived unanticipated factors of *UM*, *UCR*, *UIR* and *UMR*. We applied the J_T test for model fit (Hansen, 1982) to ensure that the model is accurately specified. Then, the β estimates were applied as inputs into the second pass regression to yield the λ's.

5. Empirical results

We conducted the Augmented Dickey Fuller (ADF) test for unit roots on *M*, *CR*, *IR* and MR up to a lag order of 5. We compared the test statistics for the highest AIC and SBC values against a 5% critical value. We found that while *M* is a stationary process and can be applied as *UM* into the estimation model, *CR*, *IR* and *MR* were non-stationary I(1) processes and had to be differenced before applied as *UCR*, *UIR* and *UMR*.

By specifying *CR*, *IR* and *MR* as variables in a VAR framework, and the intercept term C, M and M(-1) as the deterministic components, we selected a maximum order of 5 for the VAR.[8] The AIC, SBC and LR tests were all consistent in selecting a VAR of order 1. Then, the residuals for *CR*, *IR* and *MR* were estimated and saved as *UCR*, *UIR* and *UMR*. Table 2 presents the results of the VAR estimation. For *CR*, the residuals appear to be normally distributed white noise, and have no serial correlation or heteroskedasticity. The residuals for *IR* show serial correlation, heteroskedasticity and are not normally distributed. Although *MR*'s residuals have no serial correlation or heteroskedasticity, they do not conform to a normal distribution. Because the presence of serial correlation and heteroskedasticity does not affect the GMM estimation technique, and that the underlying distribution does not necessarily need to conform to a normal distribution (Hansen and West, 2002), *UCR*, *UIR* and *UMR* can be applied in our GMM framework. However, GMM does require stationarity in variables (Enders, 1995) and since our ADF tests confirm that UCR, UIR and UMR are stationary I(0) processes, we use them in our GMM estimation.

[Insert table 2 here]

We also tested our VAR(1) model for cointegrating relationships to establish the underlying dynamics of the variables. Table 3 reports the results of the Johansen ML test for cointegration. The test was conducted with no restrictions imposed on the intercepts and trends so as not to lose any valuable information about the cointegration between variables. The ***r*** values reported were used to determine the number of linearly dependent cointegrating vectors.

[Insert table 3 here]

The results of the first two tests based on maximal eigenvalues and trace statistics show that there are not cointegrating relationships between *CR*, *IR* and *MR*. However, based on model selection criteria, the AIC and HQC report three cointegrating relationships whereas SBC indicates no cointegration. Overall, the evidence is generally in favour of no cointegration between the factors. Since the *CR*, *IR* and *MR* are not cointegrated, therefore *UCR*, *UIR* and *UMR* will also not have causal relationships between them.[9]

In our first pass regressions, we used one period lagged values of the dependent and explanatory variables as the vector of instruments, suggested by Cochrane (1999). A time series HAC weighting matrix was selected, so that the estimated parameters would be robust to heteroskedasticity and autocorrelation of an unknown form. Specifically, the Bartlett kernel and appropriate bandwidth for the kernel proposed by Newey and West (1987) was applied and this determines the functional form of the kernel used to weight the autocovariances in the computation of the weighting matrix.

A summary of the number of statistically significant beta estimates derived from the sample t-statistics, as well as the proportion in relevance to their sample size is shown in table 4. We found that HCFD has the highest proportion of statistical significance towards UCR compared to its less capitalised counterpart PCFD (and PCFD2). This implies that HCFD banks keep higher levels of capital due to its greater sensitivity to credit risk. All the groups exhibit similar proportions of sensitivities to interest rate risk, with HCFD being most susceptible. PCFD banks are most sensitive to market risk, most likely due to their diversification activities being subject to market movements while they do not keep adequate capital levels to bolster against possible losses. HCNFD and PCNFD are very sensitive towards unanticipated market risk UM, most likely because their heavy reliance on traditional forms of banking activities as a source of income. If these banks focus on merely making loans and taking deposits, sudden upswings in the stock markets may result in less deposits and loans as the equity market become more attractive. Subsequently, sudden downswings in the stock markets may induce higher saving levels (and more interest to be paid out) and higher default rate on loans. This issue applies to bank in all risk groups but may affect less diversified banks to a greater extent than diversified ones.

[Insert table 4 here]

Table 5 reports the average estimated betas for each factor both for equally and value weighted portfolios in each risk profile group, and a general ranking of the sensitivities of each group against the unexpected factors. The average returns for both equally and value weighted portfolios indicate that highly capitalised banks perform better than their poorly capitalised counterparts. Also, diversified banks had lower standard deviation of returns compared to their specialised counterparts in the case of value weighted portfolios.

[Insert table 5 here]

Based on our main hypotheses, the ranking provide mixed results, with inconsistencies in the findings for equally weighted portfolios. However, the rankings for value weighted portfolios are uniform across all variables, providing evidence in support of the argument that larger banks are those that matter when the stability of financial markets are concerned.

We found that the weakest risk profile is the PCNFD group. Due to poor capital levels, these banks are particularly susceptible to sudden changes in market, credit, interest rate and maturity risks. Additionally, without adequate diversification, these banks are unable to engage in other activities to reduce the heavy reliance on interest income.

HCFD banks also exhibited surprisingly poor insulation against unexpected shocks, although our hypotheses expected this group to be the strongest. A possible explanation of this is that high capitalisation has nothing to do with strengthening the banks, but instead reflect the deterioration of creditworthiness of their borrowers. Another plausible conclusion relates to the fact that East Asian banks tend to have more concentrated ownership patterns, thus making the banks very risky. Sach et al., 1996 have already noted that the implementation of capital standards have not been particularly encouraging for emerging markets. Our results for HCFD banks support Rojas-Suarez's (2001) findings that capitals standards for emerging markets do not possess useful supervisory powers compared to developed economies. This is due to the diverse structures of their financial sectors, different accounting standards and most importantly, lack of standardisation in the classification of capital to be included in capital adequacy ratios.

The PCFD banks were better insulated against the risk factors. However, the importance of high capital levels should not be quickly dismissed, as our rankings reveal that HCNFD banks were on average, the least sensitive against the unanticipated risk factors.

We then applied the J_T test for over-identifying restrictions on the estimated model to see how well our model "fitted" the data. The test statistic conforms to a chi-squared distribution with the degrees of freedom equal to the number of over-identifying restrictions, L – K. There were nine instruments and five parameters estimated, and therefore we used four over-identifying restrictions. Table 6 summarises the number of banks in each risk profile group that rejected the null hypothesis. In our estimation of HCFD banks, only 6 out of 56 banks rejected the null hypothesis. Similarly, only 6 out of 98 PCFD banks, and 4 out of 27 PCFD2 banks indicated poor model fit. Overall, our results indicate that the GMM estimation of our four-factor model has been efficient and reliable.

[Insert table 6 here]

We then used the factor betas derived from the first-pass regressions of (1) as the explanatory variables in the cross-sectional regressions of (3). Table 7 reports the results of our second-pass regressions.

[Insert table 7 here]

For *UM*, the equally and value weighted β_{UM} for HCFD banks is positive and the risk premium λ_{UM} is also positive. This implies that HCFD banks do not wish to hedge against unanticipated market risk. Our findings also indicate the same for HCNFD banks. However, for equally weighted PCFD and PCNFD banks, the average β_{UM} was positive and λ_{UM} was found to be negative. Therefore this leads to a conclusion in support of Chen et al. (1986) that poorly capitalised banks seek to hedge against *UM*.

Upon examination of *UCR*, the β_{CR} for equally and value weighted portfolios of HCFD banks are both negative. The value weighted portfolio estimate for λ_{CR} is negative, consistent with our hypothesis. The results for HCNFD banks are mixed however, where the equally weighted beta and risk premium estimates are both negative, implying that HCNFD banks do not wish to hedge against unanticipated credit risk. However, in the results of HCNFD banks in the value weighted case indicate a propensity to hedge. In both PCFD2's portfolios, both the beta and risk premium estimates are negative, leading to our conclusion that these banks do not wish to hedge against credit risk. PCNFD banks have a positive beta and risk premium of the opposite sign in an equally weighted case implying that they do wish to hedge against credit risk but the results from a value weighted case indicate otherwise.

The results for HCFD banks are consistent with our hypotheses regarding the UIR. The beta estimates for both equally and value weighted portfolios are negative and the associated risk premiums, positive. The same desire to hedge was found for HCNFD and PCNFD but not for PCFD and PCFD2. Overall, highly capitalised banks and very weak banks exhibit the wish to hedge against *UIR* but as long as a bank is functionally diversified, even if it is poorly capitalised, it is not concerned with interest rate risk factors.

Finally, HCFD and HCNFD banks do not appear to hedge against *UMR*, whereas PCFD and PCNFD banks do. Perhaps, the highly capitalised banks hold higher levels of capital to hedge against the possible future default of their borrowers while their poorly capitalised counterparts look for other means to control for such events occurring.

6. Conclusion

Overall, our results indicate that the highly capitalised banks in our sample yield higher stock returns but may be in fact more risky because the high levels of capital they hold reflect their perceptions of riskiness in their lending portfolios. Although the capital adequacy ratios were introduced to strengthen banks from the risks inherent to financial intermediation, it appears that these banks holding more capital are merely compensating for undertaking riskier loans instead of aiming to strengthen their balance sheets. In comparison, diversified banks' returns were less volatile, echoing the benefits that diversification brings to the stabilisation of income for these banks. Our results also indicate that constructing value weighted portfolios will yield more consistent and meaningful estimates than equally weighted portfolios.

There were three main lessons to be drawn from our results. If banks are not going to be functionally diversified and rely on the traditional forms of banking, they must hold higher levels of capital to ensure their safety and soundness. However, in the case of functionally diversified banks, there would not be any use of the banks reporting high capital levels, when they may be in fact increasing their risk-taking behaviour by making out even riskier loans, in an effort to replenish equity capital. As long as the banks are functionally diversified, and provided that the composition of their lending portfolios are not changing for the worse, their efforts to diversify away risks using other non-interest income earning activities should pay off and ensure the strength of the banks against deteriorating macroeconomic conditions. Finally, poorly capitalised banks that are not engaged in adequate diversification activities should try to adopt at least one characteristic of the other groups. Fortunately, the sample indicates that there are only three of such banks and so this form of weakness in the banking system is not prevalent in East Asia.

Additionally, our results established that poorly capitalised banks do not seek to hedge against market and credit risks. However, highly capitalised banks appear to seek hedging against credit and interest rate risks. These findings suggest that the banks hold high levels of capital in an active effort to protect themselves against unanticipated risk factors. High capital levels also seem to be an effective means for protecting against possible future losses on loan portfolios, measured by the maturity risk factor.

The empirical evidence supports our hypotheses. With the importance of stable banking systems in ensuring strong financial and economic systems, the capital adequacy guidelines proposed by the Basel Committee on Banking Supervision have the potential to strengthen banks in the Asia-Pacific region, provided that consistent classifications are established in these countries. As banks are becoming increasingly universal, the benefits of corporate diversification have shown encouraging results. Thus, the role of prudential regulation and market disciplinary forces will continue to be crucial for banks.

Notes

1. Landschoot and Vander Vennet (2001) conducted a similar study with a sample of banks from Europe, Norway, Switzerland, U.S., Canada and Australia. Their study accounted primarily on credit risk, but also examined the effects of bank risk profiles on market and maturity risks. All banks in their sample conformed to the BIS capital adequacy standard of 8%.

2. Additional evidence showing that banks do reduce lending to riskier companies in an effort to control capital levels on their balance sheets have also been presented by Dahl and Shrieves (1990), Peek and Rosengren (1997) and Jacques and Nigro (1997).

3. Sironi (2002) also warns that with recent developments in capital regulation, the role of prudential supervision would be outdated and the role of market forces in controlling banks' risk taking behaviour must be increased. Crockett (2002) notes that in order for market disciplinary forces to be effective, the market must possess sufficient information, sufficient processing ability for that information, the right incentives to act on them and the proper channels to exercise discipline.

4. CAMEL indicators are capital adequacy, asset quality, management quality, earnings and liquidity.

5. Campbell, Lo and Mackinlay (1997, p. 226) also present an excellent interpretation of the APT model that allows for multiple risk factors in approximating expected returns.

6. All relevant data was obtained from Datastream.

7. With the introduction of the new risk profile group PCFD2, the sample size of the group decreases to 27 banks and therefore the total sample reduces to 91 banks.

8. Orders of 6 to 10 were also tested and all revealed the same results as an order of 5.

9. Granger causality tests were conducted on UCR, UIR and UMR and so causal relationships were found between the variables for lags up to 5 time periods.

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Table 1: Number of banks in each risk profile group

		Non-Interest Income / Total Income	
		FD > 15%	NFD < 15%
Total Equity / Total Assets	HC > 6%	56	5
	PC < 6%	98	3

Notes: This table shows the breakdown of the 162 banks used in this study into the various risk profile groups. Highly capitalised (HC) banks are those with an equity-to-assets ratio of over 6%, and Functionally Diversified (FD) banks are those with a ratio of non-interest income to total income of more than 15%. These thresholds are applied by Fitch/IBCA Bankscope in assessment of banks and producing their credit ratings.

Table 2: VAR estimation results for CR, IR and MR

VAR estimation results for CR

	CR(-1)	IR(-1)	MR(-1)	M	M(-1)
Coef	0.96012	0.01052	-0.01302	0.00030	-0.00303
T-ratio	39.69700	2.43990	-1.45270	0.19279	-1.95460
	[.000]	[.016]	[.149]	[.847]	[.053]

Serial Correlation	Functional Form	Normality	Heteroscedasticity
15.14110	0.02156	2.27520	0.00159
[.234]	[.883]	[.321]	[.968]

VAR estimation results for IR

	CR(-1)	IR(-1)	MR(-1)	M	M(-1)
Coef.	-0.20023	0.98933	0.10217	-0.00743	0.00651
T-Ratio	-2.35550	65.31780	3.24470	-1.37170	1.19660
	[.020]	[.000]	[.002]	[.173]	[.234]

Serial Correlation	Functional Form	Normality	Heteroscedasticity
24.56830	6.64080	187.38090	7.05490
[.017]	**[.010]**	**[.000]**	**[.008]**

VAR estimation results for MR

	CR(-1)	IR(-1)	MR(-1)	M	M(-1)
Coef.	0.23216	-0.01534	0.93918	0.00536	0.00096
T-ratio	2.89520	-1.07360	31.61710	1.04960	0.18788
	[.005]	[.285]	[.000]	[.296]	[.851]

Serial Correlation	Functional Form	Normality	Heteroscedasticity
7.70080	0.34071	23.17310	0.88508
[.808]	[.559]	**[.000]**	[.347]

Notes: The T-ratios for each coefficient is the ratio of the coefficient and its standard error. The probability values of the T-ratios are reported in parenthesis underneath. Generally, a T-ratio greater than 2, or a probability value of less than 0.05 indicates that the corresponding coefficient is statistically significant in determining the dependent variable at a 95% level of significanceIn the diagnostic tests on the residuals, the test for serial correlation is the Lagrange multiplier test. The test for functional form is the Ramsey's RESET test using the square of the fitted values. The test for normality is based on a test of skewness and kurtosis of residuals (JB) and the test for heteroskedasticity is based on the regression of squared residuals on squared fitted values (White Test). All the diagnostic tests statistics reported are distributed as χ^2 under the null and compared against a p-value, reported in the paranthesis, of 0.05. When the reported p-value is less than 0.05, then the null hypothesis of no serial correlation, accurate functional form, normality and homoskedasticity are rejected. All statistically significant probability values are in bold.

Table 3: Results of Johansen ML test for cointegrating relationships

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Order of VAR = 1.
List of variables included in the cointegrating vector: CR IR MR
List of I(0) variables included in the VAR: M M(-1)
List of eigenvalues in descending order: .15912 .092643 .034015

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	20.4505	24.3500	22.2600
r<= 1	r = 2	11.4719	18.3300	16.2800
r<= 2	r = 3	4.0836	11.5400	9.7500

Cointegration LR Test Based on Trace of the Stochastic Matrix

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	36.0061	39.3300	36.2800
r<= 1	r>= 2	15.5555	23.8300	21.2300
r<= 2	**r = 3**	4.0836	11.5400	9.7500

Choice of the Number of Cointegrating Relations Using Model Selection Criteria

Rank	Maximized LL	AIC	SBC	HQC
r = 0	1721.6	1709.6	**1693.0**	1702.9
r = 1	1731.8	1714.8	1691.3	1705.3
r = 2	1737.6	1717.6	1689.9	1706.3
r = 3	1739.6	**1718.6**	1689.5	**1706.8**

Notes: When the statistic is less than the critical value, the null hypothesis cannot be rejected in favour of the alternative. The **r** is used to determine the number of cointegrating vectors. Figures in bold show the test results based on each of the three tests.

Table 4: Number of statistically significant beta estimates

	HCFD	HCNFD	PCFD	PCFD2	PCNFD
No. of banks	56	5	98	27	3
Intercept	18 (32.14%)	0	19 (19.39%)	8 (29.63%)	0
UM	38 (67.86%)	3 (100%)	73 (74.49%)	18 (66.67%)	3 (100%)
UCR	25 (44.64%)	0	12 (12.25%)	1 (3.7%)	0
UIR	23 (41.07%)	0	22 (22.45%)	9 (33.3%)	1 (33.3%)
UMR	11 (19.64%)	0	23 (23.47%)	12 (44.4%)	0

Notes: The number of statistically significant beta estimates were determined by counting the number of corresponding t-statistics greater than 2 in absolute value. The proportions are reported in the brackets, and are simply the ratio between the number of significant estimates with the number of banks in each sample/ risk group.

Table 5: Estimated betas derived from first-pass GMM regression

Equally-weighted portfolios

	HCFD	HCNFD	PCFD	PCFD2	PCNFD
CONST	-0.00153	-0.01817	-0.00550	-0.00574	-0.04718
UM	0.46614	2.09705	0.38853	-0.55144	0.04284
UCR	-14.95657	-0.06539	0.21895	-3.13482	9.31720
UIR	-8.02658	-0.49682	-0.11761	-4.25474	-11.56019
UMR	-0.93142	-0.42510	-0.69214	1.28406	6.19220
Ave returns	-0.00039	-0.01194	-0.00699	-0.00767	-0.02591
Std Dev	0.01168	0.00635	0.00812	0.01317	0.03283

Value-weighted portfolios

	HCFD	HCNFD	PCFD	PCFD2	PCNFD
CONST	0.00008	0.00001	-0.00007	-0.00003	0.00199
UM	0.01028	-0.00121	0.00575	0.01977	0.21859
UCR	-0.28678	0.00047	-0.04979	-0.05169	-3.05287
UIR	-0.14595	0.00351	-0.00421	-0.02501	-2.47701
UMR	-0.08430	0.00681	-0.03058	-0.15535	-0.41406
Ave returns	0.00015	-0.00170	-0.00007	-0.00001	-0.00851
Std Dev	0.00073	0.00230	0.00028	0.00014	0.00638

Ranking based on equally-weighted portfolios

	UM	UCR	UIR	UMR
More sensitive	HCNFD	HCFD	PCNFD	HCFD
	HCFD	PCFD2	HCFD	PCFD
	PCFD	HCNFD	HCNFD	HCNFD
Least sensitive	PCNFD	PCNFD	PCFD	PCNFD

Ranking based on value-weighted portfolios

	UM	UCR	UIR	UMR
More sensitive	PCNFD	PCNFD	PCNFD	PCNFD
	HCFD	HCFD	HCFD	HCFD
	PCFD	PCFD2	PCFD	PCFD
Least sensitive	HCNFD	HCNFD	HCNFD	HCNFD

Notes: The first pass regressions were estimated according to equation [1] where: $R^i_t = \alpha + \beta_M UM_t + \beta_{CR} UCR_t + \beta_{IR} UIR_t + \beta_{MR} UMR_t + \varepsilon^i_t$. The unanticipated components of the factors have been estimated in the previous section and tested for cointegration. The ranking criteria is as follows: stronger banks should be less sensitive to the unanticipated components with relatively smaller betas for UM, less negative values in the case of UCR, UIR and UMR.

Table 6: Number of banks rejecting the null hypothesis of satisfactory model specification

Risk Profile Group	No. of $J_T >$ χ^2 critical value
HCFD	6
HCNFD	0
PCFD / PCFD2	6/ 4
PCNFD	0

Note: J_T = J-statistic × No. of observations. The χ^2 critical value at 4 degrees of freedom, given a 95% significance level is 9.488. If $J_T > 9.488$, the null hypothesis that the overidentifying restrictions are satisfied is rejected.

Table 7: Estimated risk premiums from the second-pass regressions

Equally-weighted portfolios	HCFD	HCNFD	PCFD	PCFD2	PCNFD
λ_0	-0.00408	-0.20078	-0.00202	-0.00072	0.02053
λ_M	**0.011907**	0.01209	**-0.012486**	**-0.014418**	-0.00551
λ_{CR}	0.00006	-0.00002	**-0.000211**	-0.00032	-0.00241
λ_{IR}	0.00014	0.00009	-0.00001	0.00005	0.00414
λ_{MR}	-0.00013	0.00011	0.00011	0.00017	0.00389

Value-weighted portfolios	HCFD	HCNFD	PCFD	PCFD2	PCNFD
λ_0	-0.00002	0.00011	-0.00001	**-0.006574**	-0.01120
λ_M	**0.010970**	1.51016	**-0.010631**	**-0.329732**	0.02489
λ_{CR}	-0.00017	-0.04216	-0.00006	-0.00030	-0.00113
λ_{IR}	**.00061**	-0.02497	-0.00162	**-0.028012**	0.00070
λ_{MR}	**-0.001217**	0.01775	0.00452	0.01028	0.01080

Notes: The risk premiums were estimated according to the second-pass regression specified in (3): $\mu_R{}^i = \lambda_0 + \beta^i{}_M \lambda_M + \beta^i{}_{CR} \lambda_{CR} + \beta^i{}_{IR} \lambda_{IR} + \beta^i{}_{MR} \lambda_{MR}$ where μ is the expected equally weighted and value weighted return for each portfolio group. The statistically significant estimates are in bold, evaluated using t-ratios greater than 2 in absolute value. T-ratios for HCNFD and PCNFD could not be derived due to the small number of banks in the samples.